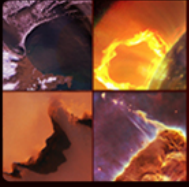


# **Update on NASA Activities toward the National Space Weather Action Plan**

Elsayed R. Talaat, NASA HQ



# National Space Weather Strategy

National Space Weather Strategy and Space Weather Action Plan were officially released on 29 October 2015

Action Plan details the activities, outcomes and timelines that will be undertaken by Federal departments and agencies for the Nation to make progress toward the strategic goals

## 6 Strategic Goals in the Action Plan

- ***Establish Benchmarks for Space-Weather Events***
- ***Enhance Response and Recovery Capabilities***
- **Improve Protection and Mitigation Efforts**
- ***Improve Assessment, Modeling, and Prediction of Impacts on Critical Infrastructure***
- ***Improve Space-Weather Services through Advancing Understanding and Forecasting***
- ***Increase International Cooperation***

NATIONAL SPACE WEATHER STRATEGY

PRODUCT OF THE  
National Science and Technology Council



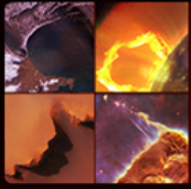
NATIONAL SPACE WEATHER ACTION PLAN

PRODUCT OF THE  
National Science and Technology Council



October 2015

**NASA is providing space weather research expertise to 40 actions in the 6 goals.**



# Goal 1: Establish Benchmarks for Space-Weather Events (5 topic areas)

Benchmarking will happen for:

1. Induced geo-electric fields
2. Ionizing radiation
3. Ionospheric disturbances
4. Solar radio bursts
5. Upper atmospheric expansion

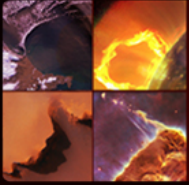
## Timeline:

Phase 1 benchmarks: 180 days (April 2016)

Complete Assessment report of gaps: 1 yr (November 2016)

Phase 2 updated benchmarks: 2 yr (November 2017)

***AGU Fall Meeting Session PA037: The National Space Weather Action Plan: Five Benchmarks for Extreme Space Weather Events***



# Action 1.2.x: Ionizing Radiation Benchmark

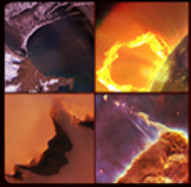
Changes in the near-Earth radiation environment can affect satellite operations, astronauts in space, commercial space activities, and the radiation environment on aircraft at relevant latitudes or altitudes.

Understanding the diverse effects of increased radiation is challenging, but the ionizing radiation benchmarks will help address these effects.

The following areas should be considered in addressing the near-Earth radiation environment: 1 the Earth's trapped radiation belts, the galactic cosmic ray background, and solar energetic-particle events. The radiation benchmarks should account for any change in the near-Earth radiation environment, which, under extreme cases, could present a significant risk to critical infrastructure operations or human health.

At a minimum, the ionizing radiation benchmarks and associated confidence levels will define at least the radiation intensity as a function of time, particle type, and energy for the following event-occurrence rate and intensity level:

- An occurrence frequency of 1 in 100 years; and
- An intensity level at the theoretical maximum for the event.



## Action 1.2.x: Ionizing Radiation Benchmarking Working Group

NASA HQ: Elsayed Talaat (lead), Arik Posner (chair), John Allen

NOAA: Terry Onsager (co-lead), Bob Rutledge

NASA JSC: Dan Fry, Eddie Semones

NASA GSFC: Eric Christian, Chris St. Cyr, Sri Kanekal, Dave Sibeck,  
Mike Xapsos

NASA LaRC: Chris Mertens

NASA MSFC: Joe Minow

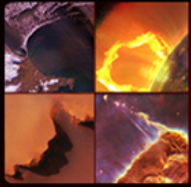
NSF: Janet Kozyra, Carrie Black

FAA: Kyle Copeland

AFRL: Doug Johnston

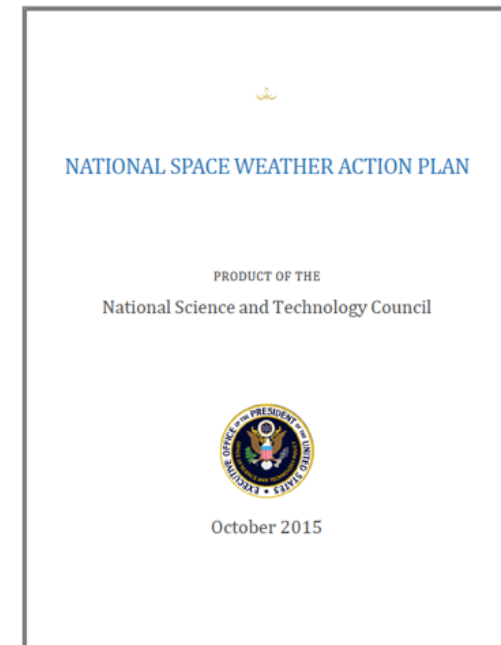
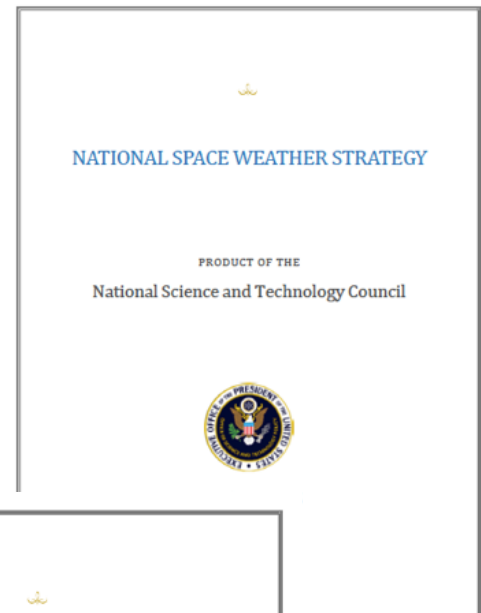
FCC: James Pierson

Weekly telecoms in March and April 2016. Use of existing literature of extreme events; methodologies developed to extrapolate to 1 in 100 year benchmark.

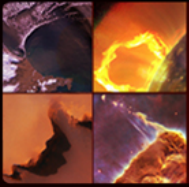


# Goal 5: Improve Space-Weather Services through Advancing Understanding and Forecasting

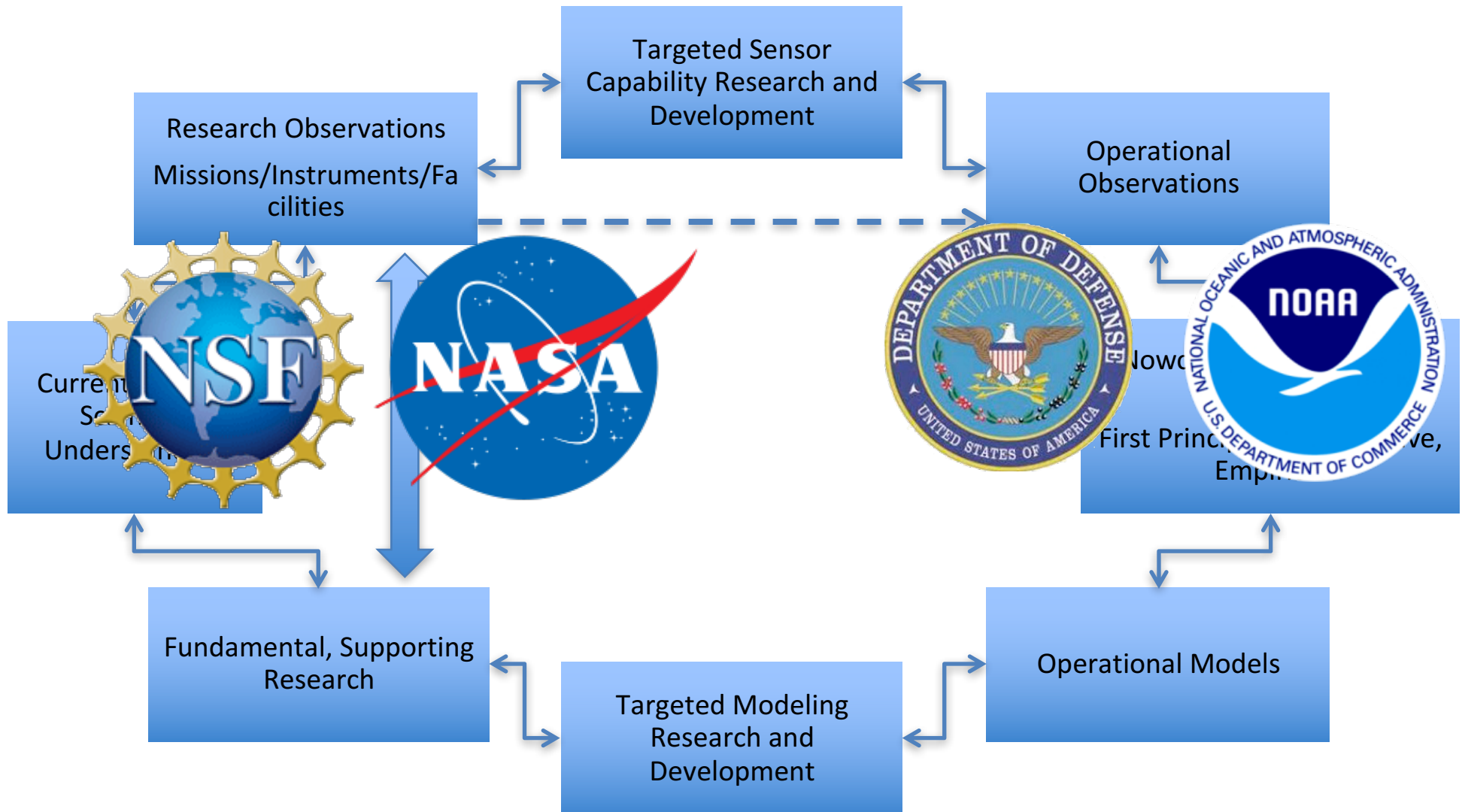
- Action 5.6 - Improve Effectiveness and Timeliness of the Process that Transitions Research to Operations
  - 5.6.1 – Develop a formal process to enhance coordination between research modeling centers and operational forecast centers (R2O)
  - 5.6.2 – Develop a plan that will ensure the improvement, testing, and maintenance of operational forecasting models leveraging existing capabilities in academia and the private sector and enable feedback from operations to research to improve operational space-weather forecasting (O2R)
- NASA, NSF, NOAA, DOD developed a coordinated briefing on R2O and O2R concepts and presented it to OMB and OSTP.

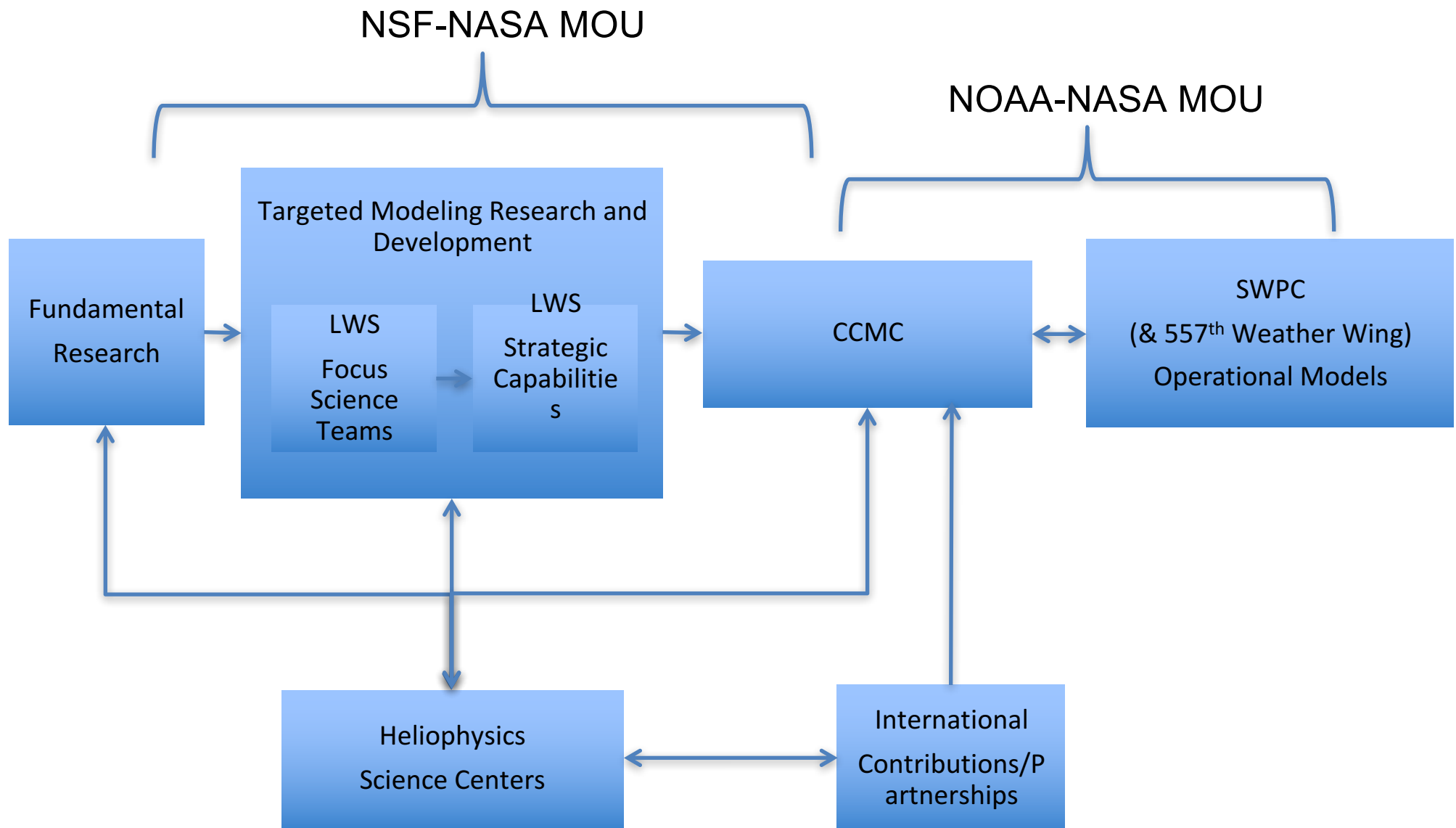




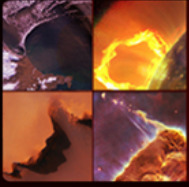


# Elements of R2O & O2R System



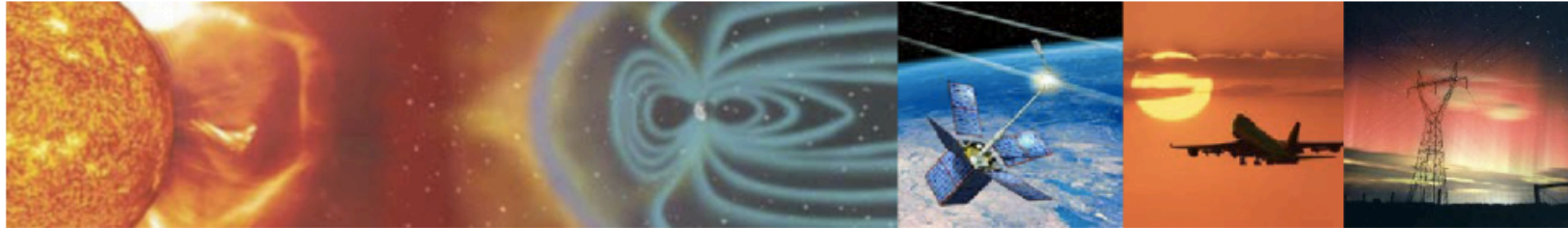






# O2R Workshop next week

## O2R WORKSHOP



### Space Weather: Operations to Research (O2R) Workshop

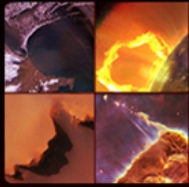
(register closed as of August 2, 2016)

**What:** A community workshop to discuss a plan for a national space weather Operations to Research capability.

**When:** August 16 – 17, 2016 (Please note: the O2R Workshop will conclude at 12:30 pm on August 17)

**Where:** NOAA David Skaggs Research Center, 325 Broadway, Boulder, CO 80305 (link provides map and directions)

<http://www.swpc.noaa.gov/content/o2r-workshop>



# Goal 6: Increase International Cooperation

## Selected Workshops and Events

January 24-29, 2016: COSPAR/ILWS Workshop, the “Science for Space Weather” was held in GOA, India

<http://www.cessi.in/ssw/information.html>



February 15-17, 2016: COSPAR/ILWS Workshop – “From Science Discovery to Applications, Services, and Infrastructure Protection”, held during the UN COPUOS Space Weather Expert Group Meeting

<http://www.unoosa.org/oosa/en/ourwork/topics/space-weather.html>



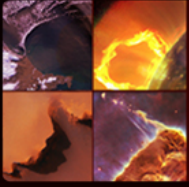
April 4, 2016: “Space Weather as a Global Challenge” held in Washington, DC.

<http://swfound.org/events/2016/space-weather-as-a-global-challenge>



George Marshall Conference Center  
U.S. Department of State  
Please RSVP by March 29 to Stephanie Wain at  
Wain@state.gov or 202-683-2672. Guests from outside  
the State Department must provide government ID number  
(Passport, Driver's license, or Agency ID) and Date of Birth.

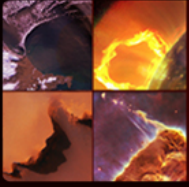




# Coordinated Group for Meteorological Satellites

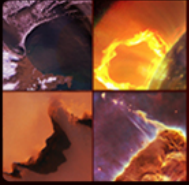
Action 6.3.3 - DOC and NASA will continue efforts within CGMS to promote an ongoing agenda item on space-weather activities.

*Space weather tasks have been integrated in core CGMS activities as of June 2016*



# **Update on Living With a Star Science**

Elsayed R. Talaat, NASA HQ



# LWS Science

## ROSES 2016:

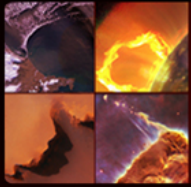
- FSTs developed incorporating inputs from previous Steering Committee reports and informed by SWAP science priorities
  - Advances Toward a Near Real Time Description of the Solar Atmosphere and Inner Heliosphere
  - Characterization of the Earth's Radiation Environment
  - Studies of the Global Electrodynamics of Ionospheric Disturbances

## ROSES 2017:

- New procedure initiated for development of FSTs
- Mandatory funding in President's FY17 budget request

*“Living with a Star is supported in part with mandatory funding. The mandatory investment includes \$10 million for Living With a Star (LWS) Science, to accelerate efforts in support of the Administration’s multi-agency Space Weather Action Plan. Work will include benchmark maturation, implementation of FY2016 plans, and continuation of planning efforts between the agencies. The investment will also augment Living with a Star Research and Analysis elements that address space weather”*

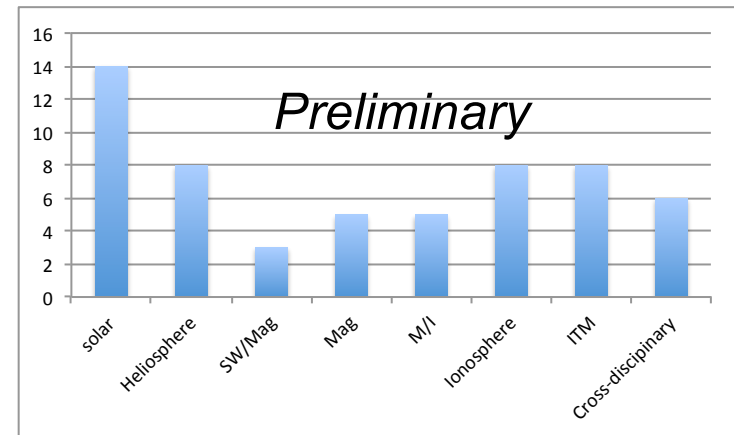
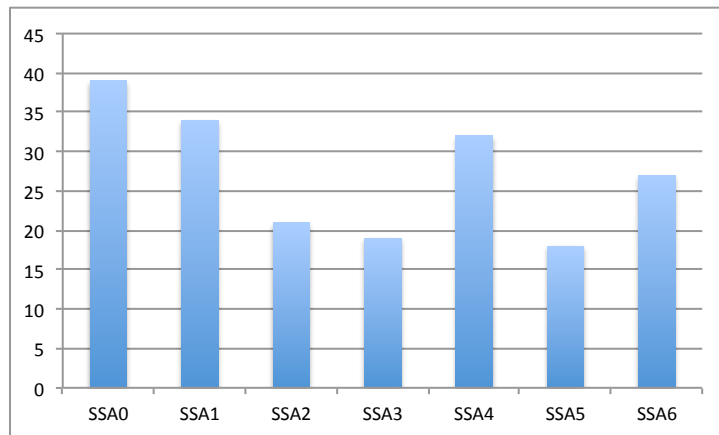




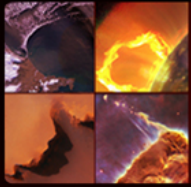
# New Procedure for Development of Annual TR&T Science Topics 1/2

## Encourage active community input to TR&T science topics:

- Announce call for community input to science topics through SPA news, Solar News, and other newsletters and e-mail lists every 2 weeks for a 6 week input period.
- Produce a short summary and explanation of this call for presentation at conferences, in newsletters, and at individual institutions.
- Hold an Online town hall where the call for topics is explained and community questions and input are solicited.
- Release the suggested science topics online as they are submitted, without submitter identifying information. Include a comment box for each topic to provide a place for comments and discussion. This page will be archived.







# New Procedure for Development of Annual TR&T Science Topics 2/2

## Draft science topics at second TSC meeting:

- At its second meeting, following the 6 week input period, the TSC develops draft science topics based on the community input received and based on the established LWS TR&T goals.

## Solicit community comment on draft TR&T science topics:

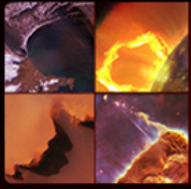
- Release (online) these draft science topics to the community for a comment period of at least 6 weeks.
- During this comment period, present these draft science topics at / via conferences, online town halls; newsletters and e-mail lists

## Finalize science topics at third TSC meeting:

- At its third meeting, following this comment period, the TSC finalizes the TR&T science topics and compiles the TSC annual report, incorporating community feedback on the previously released draft science topics.

## Findings for Future year TSCs

- Seek science topic input via:
  - Final write-up of LWS institutes.
  - Town hall and science discussion sessions at conferences.
  - Final write-up of LWS science teams.



# Living with a Star Targeted Research and Technology (TR&T) Steering Committee

## Steering Committee Members:

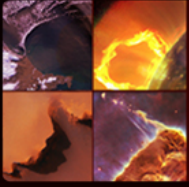
Co-Chair: Eftyhia Zesta (GSFC)  
Co-Chair: Mark Linton (NRL)  
Yuri Shprits (UCLA)  
Scott McIntosh (NCAR / HAO)  
Nathan Schwadron (UNH ex-chair)  
Jim Slavin (U Michigan)  
Chadi Salem (UC Berkeley)  
Alexa Halford (GSFC)  
Pontus Brandt (APL)  
Tim Bastian (NRAO)  
Kent Tobiska  
(Space Environment Tech.)

## Liaison Members:

Terry Onsager (NOAA)  
Rodney Vierick (NOAA)  
Ilia Roussev (NSF)  
Vyacheslav Lukin (NSF)  
Janet Kozyra (NSF)  
Masha Kuznetsova (GSFC / Community  
Coordinated Modeling Center)  
Mona Kessel (NASA HQ /  
Van Allen Probes)  
Dean Pesnell (GSFC /  
Solar Dynamics Observatory)  
David Sibeck (GSFC / Van Allen Probes)  
Adam Szabo (GSFC / Solar Probe Plus)  
Chris St. Cyr (GSFC / Solar Orbiter)

## LWS Program Ex Officio:

Elsayed Talaat & Jeff Morrill (NASA HQ), Shing Fung (GSFC)



# LWS TR&T Background

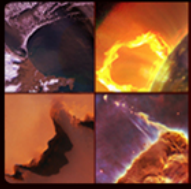
## 2003 LWS Science Definition Team Report: TR&T Program

The Targeted Research and Technology (TR&T) component of LWS provides the theory, modeling, and data analysis necessary to enable an integrated, system-wide picture of Sun-Earth connection science with societal relevance.

Science Definition Team (SDT) ... formed to design and coordinate a TR&T program having prioritized goals and objectives that focused on practical societal benefits.

**TR&T Steering Committee (TSC)**, with broad science and application community representation and with rotating membership, to advise and support NASA Headquarters in:

- Establishing and continually updating targets and top-level priorities
- Measuring the progress of the program in meeting science goals and objectives
- Providing mechanisms for monitoring how well products that result from the program are transferred into societal benefits.



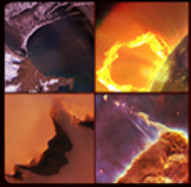
# TR&T Steering Committee Finding From February 8-9, 2016 Meeting:

## **“Procedure for Development of Annual TR&T Science Topics”**

It is vital for the success of the Living with a Star Targeted Research and Technology (LWS TR&T) program that there be active community engagement in the development of annual TR&T science topics.

The LWS TR&T Steering Committee (TSC) found that the following procedure should be followed to solicit and obtain community input for and to then develop these science topics:

- Encourage active community input to TR&T science topics
- Draft science topics at second TSC meeting
- Solicit community comment on draft TR&T science topics
- Finalize science topics at third TSC meeting



# Encourage active community input to TR&T science topics

- Announce call for community input to science topics through Space Physics and Aeronomy newsletter, Solar News, and other newsletters and e-mail lists every 2 weeks for a 6 week input period.

- ✓ 3 announcements in each newsletter sent out, starting March 13

- Produce a short summary and explanation of this call for presentation at conferences, in newsletters, and at individual institutions.

- ✓ Summary distributed by various members

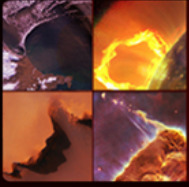
- Hold an online town hall where the call for topics is explained and community questions and input are solicited.

- ✓ Online town hall held April 8, ~35+ called in

- Release the suggested science topics online as they are submitted, without submitter identifying information. Include a comment box for each topic to provide a place for comments and discussion. This page should be archived.

- ✓ 57 topics, plus many comments, submitted and displayed online





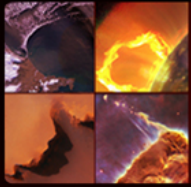
# Draft science topics at second TSC meeting

- At its second meeting, following the 6 week input period, the TSC develops draft science topics based on the community input received and based on the established LWS TR&T goals.
- Second meeting held May 15-18
- Topics drafted during and following this meeting, for May 28

Note: LWS TR&T goals target the following Strategic Science Areas (SSA's):

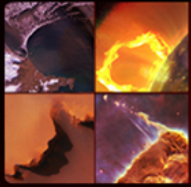
- **SSA-0:** Solar electromagnetic, energetic particle, and plasma outputs driving the solar system environment and inputs to Earth's atmosphere
- **SSA-1:** Geomagnetic Variability
- **SSA-2:** Satellite Drag
- **SSA-3:** Solar Energetic Particles
- **SSA-4:** Total Electron Content (TEC)
- **SSA-5:** Ionospheric Scintillation
- **SSA-6:** Radiation Environment





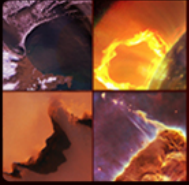
# Solicit community comment on draft TR&T science topics

- Release (online) these draft science topics to the community for a comment period of at least 6 weeks.
  - Full text of 13 draft science topics released online May 30 at [lwstr.gsfc.nasa.gov/2017DraftTopicsForComments](http://lwstr.gsfc.nasa.gov/2017DraftTopicsForComments)
  - Two additional topics released online June 21.
  - Comment period open June 1 – July 18.
- During this comment period, draft science topics presented at
  - conferences
    - Town hall held at SPD
    - Town hall held at CEDAR/GEM
    - Town hall held at SHINE
  - online town halls
  - Newsletters and e-mail lists



# Draft Topics

1. Mid-latitude and Equatorial Dynamics of the Ionosphere-Thermosphere System
2. Origins, Acceleration and Evolution of the Solar Wind
3. Ion Circulation and Effects on the Magnetosphere and Magnetosphere - Ionosphere Coupling
4. Toward a Systems Approach to Energetic Particle Acceleration and Transport on the Sun and in the Heliosphere
5. Coupling Between Different Plasma Populations by Means of Waves
6. Probabilistic Forecasting and Physical Understanding of Extreme Events
7. Understanding Physical Processes in the Magnetosphere--Ionosphere / Thermosphere / Mesosphere System During Extreme Events
8. Understanding the Impact of Thermospheric Structure and Dynamics on Orbital Drag
9. Solar Magnetic Inputs to Coronal and Heliospheric Models
10. Understanding the Response of Magnetospheric Plasma Populations to Solar Wind Structures
11. Heliospheric and Magnetospheric Energetic Precipitation to the Atmosphere and Its Consequences
12. Understanding The Onset of Major Solar Eruptions
13. Understanding Ionosphere-Thermosphere (IT) responses to high-latitude processes and Magnetospheric energy input
14. Enabling Geospace System Science Through Imaging and Distributed Arrays
15. Understanding Global-scale Solar Processes and their Implications for the Solar Interior



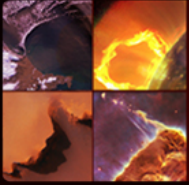
# Next Steps

## Finalize science topics at third TSC meeting:

- At its third meeting, following this comment period, the TSC finalizes the TR&T science topics and compiles the TSC annual report, incorporating community feedback on the previously released draft science topics.

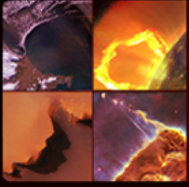
## Findings for Future year TSCs

- Seek science topic input via:
  - Final write-up of LWS institutes.
  - Town hall and science discussion sessions at conferences.
  - Final write-up of LWS science teams.



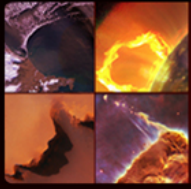
# LWS Science Update Summary

- Full text of 15 draft science topics released online May 30 to June 21 at **[lwstrt.gsfc.nasa.gov/2017DraftTopicsForComments](http://lwstrt.gsfc.nasa.gov/2017DraftTopicsForComments)**
- Comment period open June 1 – July 18.
- Town halls at SPD, CEDAR/GEM, SHINE
- Following comment period, TR&T steering committee meets to finalize topics, based on community input, LWS goals and TR&T SSA's.
- Final report will be presented to Heliophysics Subcommittee, then passed on to NASA HQ.
- NASA HQ then takes report as input for selection of 2017 TR&T science topics.
- Note: This is not input for upcoming November 2016 TR&T competition –prior year (2015 and earlier) reports fed into that.
- LWS Town Hall proposal was submitted to Fall AGU Meeting



# LWS Short-term NSWAP tasks and alignment

- LWS TR&T Steering Committee (TSC) found that NASA should establish LWS SWAP “Tiger Teams” to support the five SWAP benchmarking activities. These teams would be distinct from, but complementary to current LWS teams, such as the Focused Science Topic teams and the Strategic Capability teams.
- NASA Heliophysics Subcommittee found that LWS Program should investigate developing a broad community program by which the HPD would effectively provide the science research analysis required for the success of the SWAP.



# LWS Steering Committee Finding: Long-term traceability and alignment

- With regards to the longer-term activities identified in the SWAP report, the TSC finds that it should trace out the correspondence between all the SWAP actions to which NASA is contributing and the LWS TR&T Strategic Science Areas (SSA's).
- Based on this correspondence, the TSC should develop findings at its next meeting detailing how the TR&T's SSA-targeted activities can feed into and / or address NASA SWORM actions.
- In future years, the TSC should include SWORM efforts feedback to the program in order to more closely align TR&T activities to the SWORM goals.